AMERICAN SOCIETY

FOR

TESTING MATERIALS

ORGANIZED IN 1898
INCORPORATED IN 1902

A.S.T.M. STANDARDS

ADOPTED IN

1922

PUBLISHED BY
AMERICAN SOCIETY FOR TESTING MATERIALS
1315 Spruce Street, Philadelphia, Pa.

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PREFACE.

This pamphlet contains 12 standards adopted by letter ballot of the Society on August 25, 1922. It forms the first supplement to the 1921 Book of A.S.T.M. Standards.

CONTENTS.

STANDARDS ADOPTED BY THE SOCIETY IN 1922.

In the serial designation prefixed to the following titles, the initial letter indicative of the general classification and the first number are permanent. The final number indicates the year of adoption as standard.

B. Non-Ferrous Metals.

C. Cement, Lime, Gypsum, and Clay Products.

D. Miscellaneous Materials.

STANDARD SPECIFICATIONS

FOR

BRASS INGOT METAL, GRADED AND UNGRADED, FOR SAND CASTINGS.

Serial Designation: B 30 - 22.

These specifications are issued under the fixed designation B 30; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE, 1919; ADOPTED IN AMENDED FORM, 1922.

Material Covered.

1. These specifications cover brass ingot metal for sand castings, known commercially as red and yellow brass ingot, made wholly or partly from scrap materials. Seven typical alloys are specified and are designated Grades Nos. 1 to 7, in accordance with their decreasing copper content as specified in Section 3. These specifications also cover brass ingot metal which has no grade limit, designated as ungraded material such as a specific lot of ingots having a stated composition suitable for the buyers' needs.

I. MANUFACTURE.

Uniform Quality.

2. The manufacturer shall use care to have each lot of ingot metal as uniform in quality as possible.

II. CHEMICAL PROPERTIES AND TESTS.

Chemical Composition.

3. Individual ingots of any lot shall not show an extreme variation between the high and low copper percentages of more than 2.5 per cent and between the high and low percentages of the other main constituents, except zinc, of more than 1.5 per cent. The graded alloys shall conform to the following requirements as to chemical composition, within the limits specified in Section 4:

Alloy, Grade No.	Copper, per cent	Tin, per cent.	Lead, per cent	Zinc, per cent.	Impurities, maximum, per cent.				
					Iron.	Antimony	Aluminum	Sulfur.	Phosphorus.
1	87	8	2	3	0.25	0.25	none	0.05	0.05
2	85	5	5	5	0.35	0.25	none	0.05	0.05
3	83	4	6	7	0.35	0.25	none	0.05	0.05
4	77	3	10	10	0.40	0.35	none	0.05	0.05
5	76	2	6	16	0.40	0.25	none	0.05	0.05
6	65	1	2	33	0.50	0.20	none[1]	0.05	0.02
7	60	1½[a]	3	37	1.00	0.20	none[1]	0.05	0.02

[a] Maximum.
[1] See Appendix.

Permissible Variations.

4. The following permissible variations in the percentages of the desired elements specified in Section 3 will be allowed, but shall not apply to the maximum percentages of impurities specified:

PERCENTAGE OF ELEMENT SPECIFIED.	PERMISSIBLE VARIATIONS OVER AND UNDER THE SPECIFIED VALUE, UNITS OF PER CENT.
Not over 5 per cent	0.50
Over 5 to 15 per cent, incl	0.75
Over 15 per cent	1.00

Samples for Chemical Analysis.

5. (*a*) Ten ingots shall be selected by the inspector to represent 40,000 lb. and five ingots for less than carload lots.

(*b*) The samples for chemical analysis may be taken either by sawing, drilling or milling the ingots and shall represent the average cross-section.

(*c*) The saw, drill, cutter or other tool used shall be thoroughly cleaned. No lubricant shall be used in the operation, and the sawings or metal chips shall be carefully treated with a magnet to remove any particles of steel introduced in taking the sample.

Methods of Chemical Analysis.

6. The chemical analysis shall be made in accordance with the Tentative Methods of Chemical Analysis of Brass Ingots and Sand Castings (Serial Designation: B 45 – 22 T) of the American Society for Testing Materials.[1]

III. MARKING.

Marking.

7. The designating mark of the manufacturer, the proper lot number, and the numerical designation of the grade supplied shall be marked on each ingot for identification.

[1] *Proceedings*, Am. Soc. Test. Mats., Vol. 22, Part I (1922).

IV. INSPECTION AND REJECTION.

Inspection.

8. (*a*) Inspection may be made at the manufacturer's works where the ingots are made, or at the point at which they are received, at the option of the purchaser.

(*b*) If the purchaser elects to have inspection made at the manufacturer's works, the inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection.

9. If the test ingots selected to represent a lot fail to conform to the requirements specified in Sections 3 and 4, all ingots in such lot will be rejected.

V. CLAIMS.

Claims.

10. Claims, to be considered, shall be made in writing within thirty days of receipt of material at the purchaser's plant, and the results of the purchaser's tests shall be given. The shipper shall within one week of receipt of such claim, either agree to satisfy the claim or send a representative to the purchaser's plant to resample the shipment, as specified in Section 5. Samples so taken shall be sealed and submitted to a mutually agreeable umpire, whose determination shall be final.

Settlement of Claims.

11. The expense of umpire analysis shall be paid by the loser or divided in proportion to the concession made in case of a compromise. In case of rejection being established, the damages shall be limited to the payment of freight both ways by the manufacturer for the substitution of an equivalent weight of ingot metal meeting these specifications.

APPENDIX.

The data in the following table do not constitute a part of these specifications. They are given merely to indicate to the purchaser the physical properties of the various alloys specified which can be expected of carefully manufactured alloys of the formulas indicated, and to constitute a guide to the purchaser in selecting the grade best suited for meeting the service condition for which the ingot metal is to be used.

TABLE SHOWING PHYSICAL PROPERTIES OF BRASS INGOT METAL ALLOYS.

Alloy, Grade No.	Desired Composition.				Tensile Strength, lb. per sq. in.[1]	Elongation, in 2 in., per cent.[1]	Reduction of Area, per cent.[1]	Brinell Hardness (500 kg. for 30 sec.).	Shrinkage, in. per ft.	Weight, lb. per cu. in.
	Copper, per cent.	Tin, per cent.	Lead, per cent.	Zinc, per cent.						
1.....	87	8	2	3	30–36 000	25–30	25–30	.....	0.125	0 31
2.....	85	5	5	5	27–33 000	16–20	15–20	50–60	0 14	0.31
3.....	83	4	6	7	28–33 000	15–20	20–26	55–60	0 125	0.31
4.....	77	3	10	10	23–28 000	10–15	10-15	50–55	0.125	0.32
5.....	76	2	6	16	25–30 000	20–30	20–30	43–48	0.18	0.31
6.....	65	...	2	33	25–30 000	20–30	25–35	37–42	0.18	0.30
7.....	60	...	3	37	30–45 000	15–25	20–30	43–48	0.20	0 29

[1] The tension tests were made on "sand cast-to-size" test specimens.

Grade No.	Example of Uses.	Foundry Manipulation.	Characteristics.
1.....	High grade steam metal.....	Easily handled.....	Machines well.
2.....	High grade red brass for general service.....	Easily handled.....	Machines more readily than No 1.
3.....	Medium grade red brass for general service	Easily handled.....	Machines more readily than No. 1.
4.....	Valves and fittings for low pressures.....	Not difficult.....	Machines very easily.
5.....	Reddish yellow alloy, for air, gas and water fittings.	Not difficult.....	Machines very easily.
6.....	Yellow brass for general service.....	Difficult. Aluminum up to 0.3 per cent improves casting properties, but increases shrinkage.	Machines poorly. Not suitable for bearings or water pressure fittings.
7.....	Plumbers' flanges, scupper pipes, etc.....	Very difficult. Aluminum up to 0.3 per cent improves casting properties, but increases shrinkage.	Hard to machine. Not suitable for bearings or water pressure fittings.

STANDARD SPECIFICATIONS
FOR
NICKEL.

Serial Designation: B 39 - 22.

These specifications are issued under the fixed designation B 39; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE, 1921; ADOPTED, 1922.

Material Covered.

1. (*a*) These specifications cover four grades of Virgin Nickel, *i. e.*, nickel made from ore or matte, or similar raw material by refining processes, and not produced from remelted metal, as follows:

Electrolytic;
"X" Shot;
"A" Shot;
Ingot.

(*b*) The uses for which these four grades of Virgin Nickel are intended to be especially suitable are as follows:

Electrolytic, suitable for the manufacture of the highest grades of malleable alloys.

"X" Shot, suitable for the manufacture of Non-Ferrous Alloys and Nickel Steel.

"A" Shot, suitable for the manufacture of anodes.

Ingot, suitable for the manufacture of open-hearth and electric-furnace Nickel Steel.

I. MANUFACTURE.

Quality.

2. The maker shall use care to have each carload of as uniform quality as possible.

II. CHEMICAL REQUIREMENTS AND TESTS.

Chemical Composition.

3. The nickel shall conform to the following chemical requirements:

(*a*) *Electrolytic:*

Nickel (including cobalt)	not less than	99.50	per cent
Sulfur	" over	0.02	"
Carbon[1]	" "	0.10	"
Iron	" "	0.25	"

(*b*) *"X" Shot:*

Nickel (including cobalt)	not less than	98.90	per cent
Sulfur	not over	0.05	"
Carbon	" "	0.25	"
Iron	" "	0.60	"

(*c*) *"A" Shot:*

Nickel (including cobalt)	not less than	97.75	per cent
Sulfur	not over	0.070	"
Carbon	" "	0.75	"
Iron	" "	0.90	"

(*d*) *Ingot:*

Nickel (including cobalt) ..... not less than 98.50 per cent

It shall be reasonably free from surface corrosion and adhering foreign matter.

4. (*a*) *Electrolytic.*[1]—In all shipments cathodes shall be taken representing five per cent of the total weight shipped, but in no case shall the number of cathodes taken as samples be less than three.

Sampling.

The cathodes taken as samples shall be drilled by templet. In the case of a shipment represented by a sufficient number of cathodes, one line of holes on the templet shall be used for each cathode, *i. e.*, cathode No. 1 shall be drilled at the base, cathode No. 2 shall be drilled with one line of holes further up, etc., the resultant sample being a representation of the total sample of one whole cathode. In cases where the cathodes in the sample are less than the number of lines of holes in the templet, the sample shall be drilled using sufficient lines and fractions thereof to insure at all times a sample representative of one whole cathode. In all cases the drilling shall be done through the cathodes. The drillings obtained in the above manner shall be thoroughly mixed and divided by split sampler until the sample is about 100 g.

(*b*) *"X" Shot.*—In receiving shipments of shot, the following method of sampling shall govern: All barrels from the same melt shall be opened and a sample taken from each barrel, top, center and bottom. These barrel samples shall be mixed, quartered down to 8 oz. and broken into small pieces. This broken sample shall then be quartered down to 100 g., only material passing through a 20-mesh screen being used.

[1] The requirement for carbon in electrolytic nickel covers both contained and mechanically attached carbon from the starting sheet and it should be recognized that while lower values can be obtained by separating the cathode sheets from the starting sheet and pickling before drilling, this method of taking the sample is outside of these specifications.

(*c*) *"A" Shot.*—The sample shall be taken as described in Paragraph (*b*).

(*d*) *Ingot.*—Ingot nickel shall be sampled according to carloads whenever possible. From each carload fifty ingots shall be taken at random. In case of less than carload shipments, 5 per cent of the ingots shall be taken as a sample, but in no case shall the number of ingots taken as a sample be less than ten.

The ingots taken as samples shall be drilled by templet. In the case of a shipment represented by a sufficient number of ingots, one line of holes on the templet shall be used for each ingot, *i.e.*, ingot No. 1 shall be drilled at the base, ingot No. 2 shall be drilled with one line of holes further up, etc., the resultant sample being a representation of the total sample of one whole ingot. In cases where the ingots in the sample are less than the number of lines of holes in the templet, the sample shall be drilled using sufficient lines and fractions thereof to insure at all times a sample representative of one whole ingot. In all cases, the drilling shall be done through the ingots. The drillings obtained in the above manner shall be thoroughly mixed and divided by split sampler until the sample is about 100 g.

Methods of Analysis.

5. The chemical analysis shall be made in accordance with the Tentative Methods of Chemical Analysis of Nickel (Serial Designation: B 41 – 21 T) of the American Society for Testing Materials.[1]

III. PACKAGES.

Packages.

6. All packages and barrels shall be marked with a brand by which the maker and grade can be identified.

IV. CLAIMS.

Claims.

7. Claims in writing only shall be considered and must be submitted within 30 days of receipt of material at purchaser's plant, and with each claim shall be submitted the results of purchaser's tests. The seller shall be given one week from date of receipt of such claim to investigate his records and shall then agree either to satisfy the claim or to send a representative to the purchaser's mill.

(*a*) *Chemical Defects.*—No claims shall be considered unless the purchaser can submit to seller's representative the minimum sample of the grade specified in question.

(*b*) *Physical Defects.*—No claims shall be considered unless the purchaser can submit unused samples of the material in question to seller's representative.

Plant Treatment.

8. Where the material satisfied the chemical and physical requirements of these specifications, it shall not be condemned for defects of alloys in which it is used.

[1] *Proceedings*, Am. Soc. Test. Mats., Vol. 21, p. 522 (1921).

Investigation of Claims.

9. The maker's representative shall inspect all pieces where the physical defects are claimed. If agreement is not reached the question of fact shall be submitted to a mutually agreeable umpire, whose decision shall be final.

On a question of metal contents a sample shall be taken by representatives of both parties as described under that paragraph of Section 4 applicable to the material in question. The properly mixed sample shall be separated into three parts, each of which shall be placed in a sealed package, one for each party and one for an umpire, if necessary. Each party shall make analysis, as specified in Section 5, and if the results do not establish or dismiss the claim to the satisfaction of both parties, the third sample shall be submitted to a mutually agreeable umpire, who shall determine the question of quality, and whose determination shall be final.

Settlement of Claims.

10. The expenses of the seller's representative and of the umpire shall be paid by the loser or divided in proportion to concession made in case of compromise.

In case of rejection being established, damages shall be limited to payment of freight both ways by the seller and substitution of an equivalent weight of nickel meeting specifications for the grade in question.

STANDARD SPECIFICATIONS
FOR
CALCINED GYPSUM.

Serial Designation: C 23 - 22.

These specifications are issued under the fixed designation C 23; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE, 1919; ADOPTED IN AMENDED FORM, 1922.

I. MATERIALS AND STANDARDS.[1]

Testing. 1. The chemical and physical properties of calcined gypsum shall be determined in accordance with the Tentative Methods of Testing Gypsum and Gypsum Products (Serial Designation: C 26 – 21 T) of the American Society for Testing Materials.[2]

Definition. 2. Calcined gypsum is the product resulting from the partial dehydration of gypsum by means of heat.

Sizes. 3. Calcined gypsum may be marketed in either of the following sizes:

No. 1.—Material of this size shall all pass a 14-mesh sieve, and not less than 75 per cent of it shall pass a 100-mesh sieve.

No. 2.—Material of this size shall all pass a 14-mesh sieve, and not less than 40 nor more than 75 per cent of it shall pass a 100-mesh sieve.

NOTE.—A tolerance provision of 1 per cent on all sieve determinations is permitted.

Fineness. 4. Calcined gypsum may be marketed in any of the sizes enumerated for calcined gypsum in Section 3. Each package or each shipment, shipped for resale, shall be accompanied by a tag or card which shall contain the information required by Section 10.

[1] Specifications for the color and plasticity of calcined gypsum will be supplied when the information is available.

[2] *Proceedings*, Am. Soc. Test. Mats., Vol. 21, p. 590 (1921).

Time of Setting.

5. (*a*) The time of set of calcined gypsum shall be suitable for the purposes intended, and shall conform to the provisions prescribed for such in the Standard Specifications for Gypsum Plasters (Serial Designation: C 28) of the American Society for Testing Materials.[1]

(*b*) Calcined gypsum for molding or casting shall set in not less than 10 minutes nor more than 40 minutes.

Tensile Strength.

6. (*a*) Calcined gypsum shall have a tensile strength of not less than 200 lb. per sq. in. (14 kg. per sq. cm.).

(*b*) Calcined gypsum for molding or casting shall have a tensile strength of not less than 200 lb. per sq. in. (14 kg. per sq. cm.).

Compressive Strength.

7. (*a*) Calcined gypsum shall have a compressive strength of not less than 1000 lb. per sq. in. (70 kg. per sq. cm.).

(*b*) Calcined gypsum for molding or casting shall have a compressive strength of not less than 1000 lb. per sq. in. (70 kg. per sq. cm.).

II. SAMPLING.

Sampling.

8. At least 3 per cent of the packages shall be sampled, and shall be so selected as to be representative of the contents of the shipment. Samples shall be taken from both the surface and the center of the packages. The material so obtained shall be thoroughly mixed and reduced by quartering to provide not less than a 15-lb. (6.75 kg.) sample for the laboratory.

Laboratory Samples.

9. All laboratory samples shall immediately be placed in an air-tight container and shipped to the laboratory for test.

III. PACKING AND MARKING.

Packing and Marking.

10. Calcined gypsum may be shipped in either packages or in bulk.

(*a*) When shipped for resale, the following information shall be legibly marked on each package or on a tag of suitable size attached thereto:

Name of manufacturer;
Brand;
Description;
Net weight of package.

(*b*) When shipped in bulk, a card containing the required information shall be conspicuously placed in the carrier.

[1] 1921 Book of A.S.T.M. Standards.

IV. INSPECTION AND REJECTION.

Inspection.

11. Inspection may be made either at the point of shipment or at the point of delivery. The inspector representing the purchaser shall have free access to the carriers being loaded for shipment to the purchaser. He shall be afforded all reasonable facilities for inspection and sampling, which shall be so conducted as not to interfere unnecessarily with the loading of the carriers.

Rejection.

12. Any rejection shall be based upon the specific cause of failure to conform to the requirements of these specifications and shall be reported within ten working days from the receipt of the shipment by the consignee.

Rehearing.

13. Claims for rehearing shall be valid only if made within 20 working days from receipt of notice of specific cause for rejection.

STANDARD METHOD OF TEST

FOR

VOIDS IN FINE AGGREGATE FOR CONCRETE.

Serial Designation: C 30 - 22.

This method is issued under the fixed designation C 30; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE, 1920; ADOPTED, 1922.

Formula for Voids.

1. The voids in fine aggregate for cement concrete shall be determined by the formula:

$$\text{Percentage of Voids} = \frac{(\text{Sp. gr.} \times 62.355) - \text{Wt.}}{\text{Sp. gr.} \times 62.355} \times 100$$

Symbol "Sp. Gr."

2. The symbol "Sp. gr." represents the Apparent Specific Gravity of the fine aggregate as determined by the Standard Method of Test for Apparent Specific Gavity of Sand, Stone and Slag Screenings, and Other Fine Non-Bituminous Highway Materials (Serial Designation: D 55) of the American Society for Testing Materials.[1]

Weight of Water.

3. The quantity 62.355 is the weight in pounds of one cubic foot of water at the standard temperature of 16°.7 C. (62° F.)

Symbol "Wt."

4. The symbol "Wt." represents the weight in pounds per cubic foot of the fine aggregate as determined by the Standard Method of Test for Unit Weight of Aggregate for Concrete (Serial Designation: C 29) of the American Society for Testing Materials.[1]

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[1] 1921 Book of A.S.T.M. Standards.

STANDARD METHOD OF TEST
FOR
ORGANIC IMPURITIES IN SANDS FOR CONCRETE.

Serial Designation: C 40 - 22.

This method is issued under the fixed designation C 40; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE, 1921; ADOPTED, 1922.

Scope. 1. The test herein specified is an approximate test for the presence of injurious organic compounds in natural sands for cement mortar or concrete. The principal value of the test is in furnishing a warning that further tests of the sand are necessary before they be used in concrete. Sands which produce a color in the sodium hydroxide solution darker than the standard color should be subjected to strength tests in mortar or concrete before use.

Sample. 2. (*a*) A representative test sample of sand of about 1 lb. shall be obtained by quartering or by the use of a sampler.

Procedure. (*b*) A 12-oz. graduated glass prescription bottle shall be filled to the $4\frac{1}{2}$-oz. mark with the sand to be tested.

(*c*) A 3-per-cent solution of sodium hydroxide (NaOH) in water shall be added until the volume of sand and liquid after shaking gives a total volume of 7 liquid ounces.

(*d*) The bottle shall be stoppered and shaken thoroughly and then allowed to stand for 24 hours.

(*e*) A standard color solution shall be prepared by adding 2.5 cc. of a 2-per-cent solution of tannic acid in 10-per-cent alcohol to 22.5 cc. of a 3-per-cent sodium hydroxide solution. This shall be placed in a 12-oz. prescription bottle, stoppered and allowed to stand for 24 hours, then 25 cc. of water added.

Color Value (*f*) The color of the clear liquid above the sand shall be compared with the standard color solution prepared as in Paragraph (*e*) or with a glass of color similar to the standard solution.

3. Solutions darker in color than the standard color have a "color value" higher than 250 parts per million in terms of tannic acid.

STANDARD METHOD OF TEST
FOR
SIEVE ANALYSIS OF AGGREGATES FOR CONCRETE.

Serial Designation: C 41 - 22.

This method is issued under the fixed designation C 41; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE, 1921; ADOPTED, 1922.

Sampling. 1. A representative test sample of the aggregate shall be selected by quartering or by use of a sampler, which after drying will give not less than the following:

(*a*) Fine aggregate, 500 g.

(*b*) Coarse aggregate or a mixture of fine and coarse aggregates, weight in grams, 3000 times size of largest sieve required, measured in inches.

TABLE I.

Sieve Number[1] or Size in inches.	Sieve Opening.		Wire Diameter.		Tolerance, per cent.		
	in.	mm.	in.	mm.	Average Opening.	Wire Diameter.	Maximum Opening
No. 100	0.0059	0.149	0.0040	0.102	6	20	40
No. 50	0.0117	0.297	0.0074	0.188	6	20	40
No. 30	0.0232	0.59	0.0130	0.33	4	10	25
No. 16	0.0469	1.19	0.0213	0.54	3	10	10
No. 8	0.0937	2.38	0.0331	0.84	3	10	10
No. 4	0.187	4.76	0.050	1.27	3	10	10
$\frac{3}{8}$-in.	0.375	9.5	0.092	2.33	3	10	10
$\frac{3}{4}$-in.	0.75	19.0	0.135	3.42	3	10	10
1-in.	1.00	25.4	0.162	4 12	3	10	10
$1\frac{1}{2}$-in.	1.50	38.0	0.177	4.50	3	10	10
2-in.	2.00	50.8	0.192	4.88	3	10	10
3-in.	3.00	76.0	0.25	6.3	3	10	10

[1] Sieves No. 100 to No. 4 are based on "Table of Fundamental Data on Standard Specifications for Sieves" issued by the U. S. Bureau of Standards, 1920. The liberal tolerances will permit the use of certain sieves which do not exactly correspond to the numbers given in the table.

2. The sample shall be dried at not over 110° C. (230° F.) to constant weight. **Treatment of Sample.**

3. (*a*) The sieves shall be of square-mesh wire-cloth and shall be mounted on substantial frames constructed in a manner that will prevent loss of material during sifting. **Sieves.**

(*b*) The size of wire and sieve openings shall be as given in Table I.

4. (*a*) The sample shall be separated into a series of sizes by means of the sieves specified in Section 3. Sifting shall be continued until not more than 1 per cent by weight of the sample passes any sieve during 1 minute. **Procedure.**

(*b*) Each size shall be weighed on a balance or scale which is sensitive to 1/1000 of the weight of the test sample.

(*c*) The percentage by weight of the total sample which is finer *than each* of the sieves shall be computed.

5. (*a*) The percentages in sieve analysis shall be reported to the nearest whole number. **Report.**

(*b*) If more than 15 per cent of a fine aggregate is coarser than the No. 4 sieve, or more than 15 per cent of a coarse aggregate is finer than the No. 4 sieve, the sieve analysis of the portions finer and coarser than this sieve shall be reported separately.

STANDARD SPECIFICATIONS

FOR

BLOCK FOR GRANITE BLOCK PAVEMENTS.

Serial Designation: D 59 - 22.

These specifications are issued under the fixed designation D 59; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE, 1919; ADOPTED IN AMENDED FORM, 1922.

General.

1. The blocks shall be of granite of medium-size grain, showing an even distribution of constituent minerals. They shall be of uniform quality and texture throughout, and free from seams or disintegrated materials.

I. PHYSICAL PROPERTIES AND TESTS.

Physical Properties.

2. The average of three tests on sample blocks shall conform to the following requirements as to physical properties:

FOR HEAVY TRAFFIC.

Percentage of wear	not more than	3.6
(French coefficient of wear	" less "	11)
Toughness	" less "	9

FOR MODERATELY HEAVY TRAFFIC.

Percentage of wear	not more than	5.0
(French coefficient of wear	" less "	8)
Toughness	" less "	7

Methods of Testing.

3. (*a*) The percentage of wear and the French coefficient of wear shall be determined in accordance with the Standard Method of Test for Abrasion of Road Material (Serial Designation: D 2) of the American Society for Testing Materials.[1]

(*b*) The toughness shall be determined in accordance with the Standard Method of Test for Toughness of Rock (Serial Designation: D 3) of the American Society for Testing Materials.[1]

[1] 1921 Book of A.S.T.M. Standards.

II. DIMENSIONS.

4. The blocks shall conform to the following requirements as to dimensions: Dimensions.

Length on top, in	8 to 12
Width on top, in	$3\frac{1}{2}$ to $4\frac{1}{2}$
Depth, in	$4\frac{3}{4}$ to $5\frac{1}{4}$

III. DRESSING.

5. (*a*) The blocks shall be so dressed that the faces will be approximately rectangular in shape, and the ends and sides sufficiently smooth to permit the blocks to be laid with joints not exceeding $\frac{1}{2}$ in. in width at the top, and for 1 in. downward therefrom, and not exceeding 1 in. in width at any other part of the joint. Dressing.

(*b*) The wearing surface of the blocks shall show no depressions more than $\frac{3}{8}$ in. in depth, and the edges and corners shall be unchipped and unbroken.

IV. INSPECTION.

6. (*a*) At least six blocks shall be selected for physical tests by the engineer or his authorized representative, subsequent to delivery at the place of use, so as to fairly represent actual deliveries. No sample shall include blocks that would be rejected by a visual examination. The bedding plane shall be marked on at least two of the blocks selected. Inspection.

(*b*) All deliveries shall be subjected to further inspection at the place of use, prior to and during laying. All blocks which fail to conform to the requirements of Sections 1, 4 and 5 shall be rejected.

STANDARD METHOD OF TEST

FOR

MELTING POINT OF PARAFFIN WAX.

Serial Designation: D 87 - 22.

This method is issued under the fixed designation D 87 ; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE, 1921; ADOPTED, 1922.

I. DEFINITION.

Definition.

1. *A.S.T.M. Paraffin Wax Melting Point.*—The temperature at which melted paraffin wax, when allowed to cool under definite specified conditions, first shows a minimum rate of temperature change.

NOTE.—The so-called "American Melting Point" is an arbitrary figure 3° F. higher than the A.S.T.M. Paraffin Wax Melting Point.

II. APPARATUS.

Containers.

2. *Wax Container.*—Test tube of standard form, 25 mm. (1 in.) outside diameter and 100 mm. (4 in.) long. It may be marked with a filling line, 2 in. above the bottom. This test tube shall be closed by a tightly fitting cork having two openings, one at the center for the melting point thermometer and the other for a stirrer at one side of the center. The opening for the stirrer may be lined with glass or metal tubing to act as a guide for the stirrer.

Air Bath.

3. *Air Bath.*—Suitable water-tight cylinder, 2 in. in inside diameter and $4\frac{1}{2}$ in. deep. This air bath shall be provided with a tightly fitting cork having a central opening for holding the test tube firmly in a vertical position in the center of the air bath.

Water Bath.

4. *Water Bath.*—Suitable cylinder, $5\frac{1}{8}$ in. in inside diameter and 6 in. deep. This water bath shall be provided with a suitable cover and with the guides and fasteners necessary to hold the air bath firmly in a vertical central position so that the sides and bottom of the air bath shall be surrounded by a layer of water $1\frac{1}{2}$ in. thick. The water bath cover shall have a slot for introduction of a suitable stirrer and shall have an opening for the bath thermometer so that the latter

may be suspended in a vertical position $\frac{3}{4}$ in. from the outside wall of the water bath. Air bath, water bath and water bath cover may be conveniently made of metal in one assembly as shown in Fig. 1.

5. *Stirrer in test tube.*—Brass or copper wire, $\frac{1}{8}$ in. in diameter and about 12 in. long. A circular loop, $\frac{1}{2}$ in. in diameter, shall be formed at one end of this wire in such a manner that the loop lies in a hor- Stirrer.

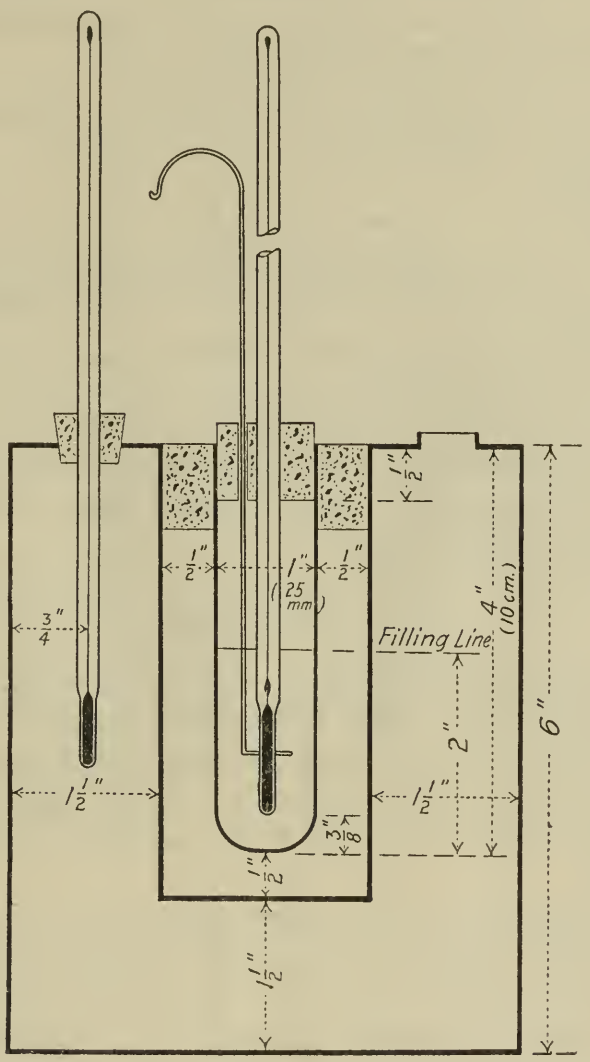


FIG. 1.—Apparatus for Determination of Melting Point of Paraffin Wax.

izontal plane when the rest of the wire is in a vertical position. The stirrer thus formed shall be passed through the proper opening in the test-tube cork and the upper end may then be bent into a shape convenient for holding.

6. *Thermometer.*—The A.S.T.M. Paraffin Wax Melting Point thermometer shall conform to the following specifications: Thermometer

Type: Etched stem glass.
Total Length: 368 mm.
Stem: Plain front, enamel back, suitable thermometer tubing. Diameter, 6 to 7 mm.
Bulb: Corning Normal, Jena 16 III or equally suitable thermometric glass. Length, maximum, 28 mm. Diameter not greater than stem.
Actuating liquid: Mercury.
Range: 80 to 160° F.
Immersion: 3⅛-in. The words "3⅛-in. Immersion" shall be etched on the stem and also a line around the stem to indicate the depth of immersion.
Distance to 80° line from bottom of bulb: 105 to 115 mm.
Distance to 160° line from top of stem: 25 to 40 mm.
Contraction chamber: Top to be not more than 41 mm. from bottom of bulb.
Expansion chamber: To hold 212° F.
Filled: Nitrogen gas.
Top finish: Plain.
Graduation: All lines, figures and letters to be clean cut and distinct. Scale graduated in 0.2° F. and numbered every 2° F., every full degree line to be longer than the others.
Special markings: "A.S.T.M. Pffe. M. P." Serial No. and manufacturer's name or trade mark etched on the stem.
Accuracy: Error at any point on scale shall not exceed one smallest scale division.
Points to be tested for certification: 80°, 100°, 120°, 140°, 160° F.

Bath Thermometer.

7. Bath thermometer of any suitable type, accurate to 2° F. throughout the required range.

III. PROCEDURE.

Procedure.

8. An average sample of the wax to be tested shall be melted in a suitable container in a water bath whose temperature shall be not more than 35° F. above the approximate melting point of the wax sample. Direct heat, such as a flame or hot plate, shall not be used and the wax sample shall not be held in the melted condition any longer than necessary.

The test tube shall be filled with melted wax to a height of 2 in. The test-tube cork, carrying the stirrer and the melting point thermometer with the 3⅛-in. immersion line at the under surface of the cork, shall be inserted into the test tube for a distance of ½ in. The lower end of the thermometer bulb shall then be ⅜ in. from the bottom of the test tube.

The air bath being in its proper position in the water bath, the latter shall be filled to within ½ in. of the top with water at a temperature 15 to 20° F. below the approximate melting point of the wax sample.

The test tube containing the melted wax, with wax stirrer and thermometer in place, shall be inserted into the air bath in a central vertical position so that the bottom of the test tube is ½ in. from the

bottom of the air bath. The temperature of the water bath shall be adjusted by stirring if necessary, so that it shall be lower than the temperature of the wax sample by not more than 30° F. and not less than 25° F., when the wax sample has cooled to a temperature 10° F. above its approximate melting point.

When these conditions have been obtained, temperature adjustment and stirring of the water bath shall be discontinued. The wax shall be stirred continuously during the remainder of the test, the stirring loop being moved up and down throughout the entire length of the test tube in a steady motion at the rate of 20 complete cycles per minute. The melting point thermometer reading, estimated to 0.1° F. shall be observed and recorded every 30 seconds. The temperature of the wax will fall gradually at first, will then become almost constant and will then again fall gradually.

The melting point thermometer reading, estimated to 0.1° F., shall be observed and recorded every 30 seconds, for at least three minutes after the temperature again begins to fall after remaining almost constant. The record of temperature readings shall then be inspected and the average of the first four readings that lie within a range of 0.2° F. shall be considered as the uncorrected melting point. This temperature shall be corrected if necessary for error in the thermometer scale and the corrected temperature shall be reported as the "A.S.T.M. Paraffin Wax Melting Point."

IV. ACCURACY.

Accuracy.

9. Duplicate determinations on the same sample should differ by not more than 0.2° F.

STANDARD METHOD OF TEST
FOR
FLASH POINT BY MEANS OF THE PENSKY-MARTENS CLOSED TESTER.

Serial Designation: D 93 - 22.

This method is issued under the fixed designation D 93 ; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE, 1921; ADOPTED IN AMENDED FORM, 1922.

Scope.

1. The A.S.T.M. standard Pensky-Martens closed tester shall be used for determining the flash point of fuel oil unless the use of the Tag closed tester is specified.

I. APPARATUS.

Pensky-Martens Tester.

2. The Pensky-Martens tester, a diagram of which appears in Fig. 1, shall include the following major parts:

(*a*) *Cup.*—The cup of the A.S.T.M. Pensky-Martens flash tester shall be made of brass and shall satisfy the following dimensional specifications:

	Inches.			Centimeters.		
Dimensions.	Minimum.	Normal.	Maximum.	Minimum.	Normal.	Maximum.
Inside diameter below filling mark	1.950	2.000	2.050	4.953	5.080	5.207
Difference, inside and outside diameters below filling mark	0.120	0.125	0.130	0.305	0.318	0.330
Inside height	2.150	2.200	2.250	5.461	5.588	5.715
Thickness of bottom	0.070	0.095	0.120	0.178	0.241	0.305
Distance from rim to filling mark	0.845	0.860	0.875	2.146	2.184	2.223
Distance lower surface flange to bottom of cup	1.780	1.795	1.810	4.521	4.559	4.597

The inside of the cup may be turned to a slightly larger diameter above the filling mark and the outside may be tapered above the flange but the wall thickness at the upper edge shall be not less than 0.04 in. (0.102 cm.). The flange should be approximately 0.5 in. (1.27 cm.) wide and approximately 0.125 in. (0.318 cm.) thick. It

shall be equipped with devices for locating the position of the lid on the cup and the cup in the stove. A handle, attached permanently to the flange of the cup, is a desirable accessory.

(*b*) *Lid.*—

1. Stirring Device.—The lid shall be equipped with a stirring device consisting of a vertical steel shaft, not less than 0.1 in. (0.254 cm.) nor more than 0.125 in. (0.318 cm.) in diameter, mounted in the

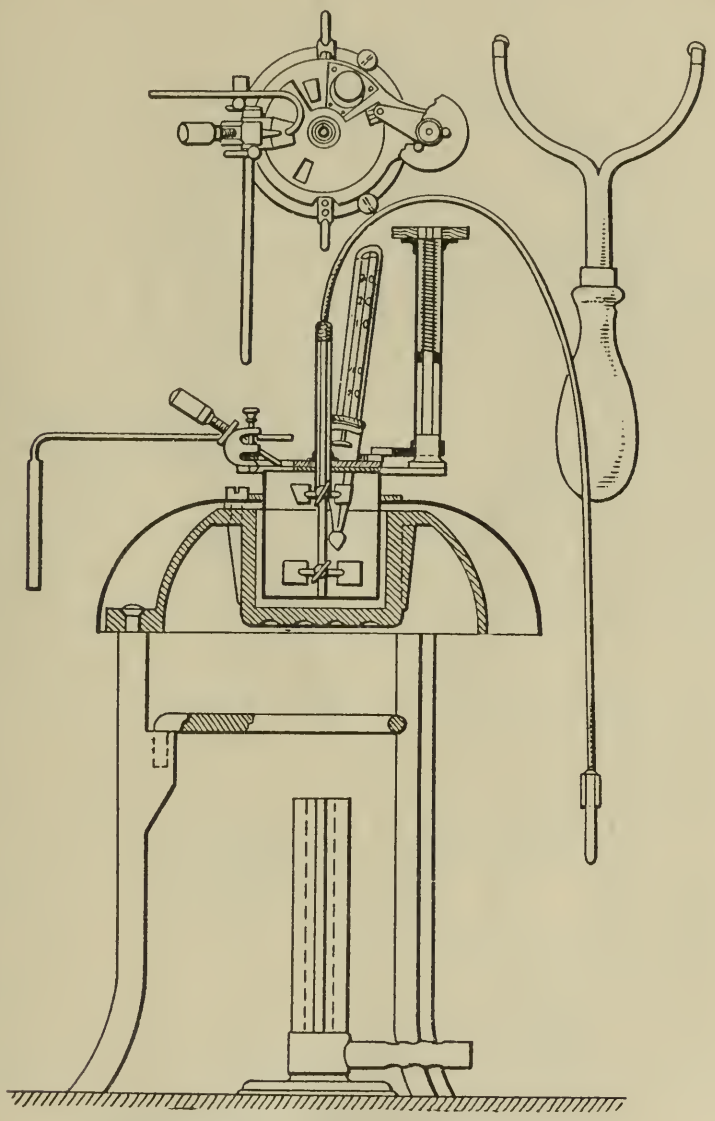
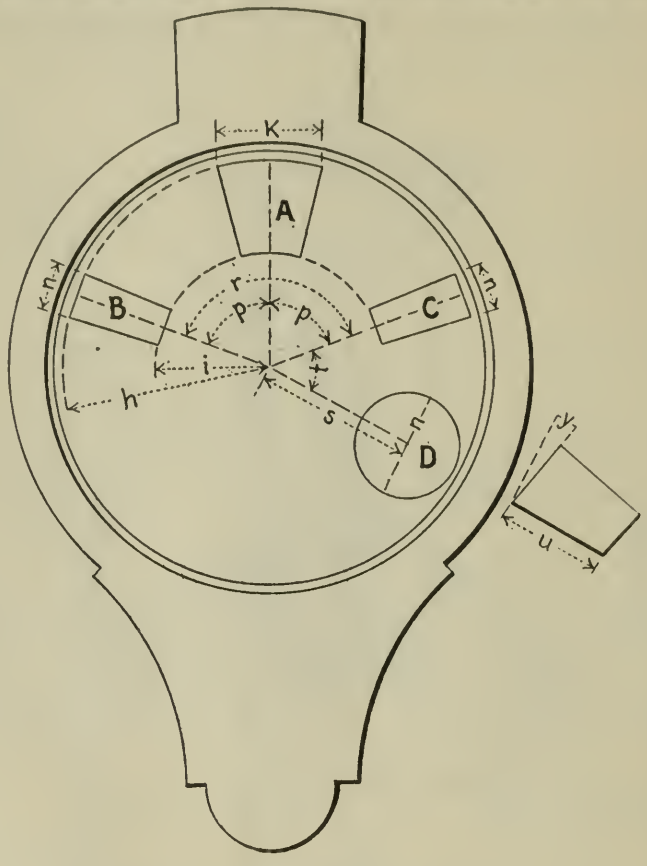


FIG. 1.—The Pensky-Martens Tester.

center of the cup, and carrying two two-bladed brass propellers. The blades of both propellers shall be approximately 0.313 in. (0.795 cm.) wide and shall be set at an angle of approximately 45 deg. The smaller (upper) propeller shall have an over-all diameter of approximately 0.75 in. (1.905 cm.). The larger (lower) propeller shall have

an over-all diameter between 1.25 and 1.75 in. (3.175 and 4.445 cm.). The thickness of the propeller blades shall be not less than 0.057 in. (0.145 cm.) nor more than 0.081 in. (0.206 cm.), which limits correspond respectively to No. 15 and No. 12 B. and S. gage sheet brass. The collars on which the propeller blades are mounted shall have horizontal and vertical dimensions not greater than 0.4 in. (1.016 cm.).



h	*Minimum*	*0.938 in.,*	*Maximum*	*0.969 in.*
i	"	*0.531* " ,	"	*0.563* "
k	"	*0.500* " ,	"	*0.540* "
n	"	*0.187* " ,	"	*0 219* "
s	*Approximately*	*0.75 in.*		
u	"	*0.5* " .		
Angles p	-	*Equal*		
Angle r	-	*Min 135°;*	*Max.*	*140°.*
" *t*	-	" *50°;*	"	*60°.*
" *y*	-	" *10°,*	"	*15°*

FIG. 2.—Cover for Pensky-Martens Tester.

The plane of the center of the upper propeller shall be 0.4 in. (1.016 cm.) below the level of the rim of the cup. The plane of the center of the lower propeller shall be 2.0 in. (5.08 cm.) below the level of the rim of the cup. The level of the rim of the cup is in effect the level of the plane part of the portion of the lower surface of the lid inside the rim.

2. Cover proper.—The cover proper shall be of brass and shall have a rim projecting downward almost to the flange of the cup and fitting the outside of the cup closely. The thickness of the cover, measured just inside the rim shall be not less than 0.031 in. (0.079 cm.) nor more than 0.078 in. (0.198 cm.). There shall be a proper locating device engaging with a corresponding locating device on the flange of the cup.

There shall be four openings in the cover, as indicated in Fig. 2.

Opening *A* is an area defined by arcs of two concentric circles and the intersected lengths of two radii. The radius of the outer circle shall be not less than 0.938 in. (2.383 cm.) nor more than 0.969 in. (2.461 cm.). The chord of the arc of the outer circle shall be not less than 0.500 in. (1.270 cm.) nor more than 0.540 in. (1.372 cm.).

Openings *B* and *C* are equal areas, each of the same general form as opening *A* but of approximately half the (angular) width. The radii of the defining inner and outer circles shall be within the limits specified for the radii of the two circles, arcs of which partially define opening *A*. The chord of the outer arc for opening *B* or opening *C* shall be not less than 0.187 in. (0.475 cm.) nor more than 0.219 in. (0.556 cm.). The sum of the areas of openings *B* and *C* shall be not less than 75 per cent nor more than 100 per cent of the area of opening *A*. Openings *B* and *C* shall be equally distant from opening *A* and radii drawn through each of their centers shall be at an angle of not less than 135 deg. nor more than 140 deg.

Openings *A*, *B*, and *C* need not conform exactly to the shape of geometrical figures bounded by arcs of two concentric circles and intersected lengths of radii. Their boundaries must, however, fall on or between the lines indicated by the limiting values of the dimensional specification of the preceding text and of Fig. 2.

Opening *D* is for a thermometer collar. Its center is approximately 0.75 in. (1.905 cm.) from the center of the lid and on a radius at an angle of not less than 50 deg. nor more than 60 deg. from a radius passing through the center of opening *C*. The thermometer collar shall have an inside diameter of approximately 0.5 in. (1.27 cm.). It shall be set at an angle of not less than 10 deg. nor more than 15 deg. from the perpendicular.

3. Shutter.—The lid shall be equipped with a brass shutter, approximately 0.094 in. (0.239 cm.) thick operating on the plane of the upper surface of the lid. The shutter shall be so shaped and mounted that it rotates on the axis of the horizontal center of the lid between two stops so placed that when in one extreme position the openings *A*, *B*, and *C* of the lid are completely closed and when in the other extreme position these orifices are completely opened.

4. Flame exposure device.—The flame exposure device shall have a tip with an opening 0.027 in. (0.069 cm.) to 0.031 in. (0.079 cm.) in diameter. The flame exposure device shall be equipped with an operating mechanism which, when the shutter is in the "open" position, depresses the tip so that the center of the orifice is between the planes of the under and upper surfaces of the lid proper at a point on a radius passing through the center of the larger opening *A* and approximately 0.1 in. (0.254 cm.) from the outer edge of the opening.

NOTE.

A pilot flame for automatic relighting of the exposure flame should be provided.

A bead 0.156 in. (0.396 cm.) in diameter, of some suitable material, may be mounted on the lid so that the size of the test flame can be regulated by comparison.

The mechanism operating the shutter should be of the spring type and constructed so that when at rest the shutter shall exactly close the three openings. When operated to the other extreme the three openings in the lid shall be exactly open and the tip of the exposure tube shall be fully depressed.

(*c*) *Stove.*—Heat shall be supplied to the cup by means of a properly designed stove which is equivalent to an air bath. This stove shall consist of (1) an air bath and (2) a top plate on which the flange of the cup rests.

1. Air bath.—The air bath shall have a cylindrical interior 1.625 in. (4.128 cm.) to 1.656 in. (4.206 cm.) deep and a diameter not less than 0.125 in. (0.317 cm.) nor more than 0.156 in. (0.396 cm.) greater than the outside diameter of the cup. The air bath may be either a flame heated metal casting or an electric resistance element.

NOTE.

If the heating element is a flame heated metal casting it shall be so designed and used that the temperature of bottom and walls is approximately the same. On this account it should be not less than 0.25 in. (0.635 cm.) thick. The casting shall be designed so that products of combustion of the flame cannot pass up and in contact with the cup.

If the air bath is of the electric resistance type it shall be constructed so that all parts of the interior surface are heated equally. This necessitates an even distribution of resistance wire over bottom and walls and a method of construction such that heat is given out from the whole core of the resistance element rather than directly from the wire.

2. Top plate.—The top plate shall be of metal. The total distance from the upper surface of the plate to the bottom of the air bath shall exceed the distance from the under surface of the flange to the bottom of the cup by not less than 0.063 in. (0.160 cm.) nor more than 0.125 in. (0.317 cm.).

The top plate shall be mounted with an air gap between it and the air bath. The top plate may be attached to the air bath by

means of three screws and spacing bushings. The spacing bushings should be of proper thickness to define the air gap which shall be not less than 0.125 in. (0.317 cm.) nor more than 0.187 in. (0.475 cm.). The spacing bushings shall be not more than 0.375 in. (0.952 cm.) in diameter.

(*d*) *Thermometers.*—Two standard thermometers shall be used with the A.S.T.M. Pensky-Martens tester. The low range, "P. M. and Tag" thermometer shall be used for tests when the indicated reading falls within the limits 20 to 200° F. The "P.M. high" thermometer shall be used for tests when the indicated reading falls within the limits 230 to 700° F. For the range 200 to 230° F. either thermometer may be employed, depending on the convenience of the operator. The thermometers shall comply with the specifications given in Table I.

Thermometers shall be mounted so that the bottom of the bulb is 1.75 in. (4.445 cm.) below the level of the rim of the cup (which corresponds to the level of the lower surface of the portion of the lid inside the rim).

TABLE I.—SPECIFICATIONS FOR THERMOMETERS FOR PENSKY-MARTENS TESTER

	Low Range "P.M. and Tag."[1]	High Range "P.M. high."
Type	Etched stem glass.	Etched stem glass.
Total length	275 mm.	275 mm.
Stem	Plain front, enamel back, suitable thermometer tubing. Diameter 6 to 7 mm.	Plain front, enamel back, suitable thermometer tubing. Diameter 6 to 7 mm.
Bulb	Corning Normal, Jena 16 III, or equally suitable thermometric glass. Diameter less than stem, length 9 to 13 mm.	Corning Normal, Jena 16 III, or equally suitable thermometric glass. Diameter less than stem, length maximum 10 mm.
Actuating liquid	Mercury.	Mercury.
Range	20° F. to 230° F.	200° F. to 700° F.
Immersion	2¼ in. (57 mm.) from end of bulb. The words "2¼-in. immersion" etched on the stem, also a line around the stem to indicate depth of immersion.	2¼ in. (57 mm.) from end of bulb. The words "2¼-in. immersion" etched on the stem, also a line around the stem to indicate depth of immersion.

[1] The low range "P.M. or Tag" thermometer is the same instrument as that specified for use with the Tag closed tester.

	Low Range "P.M. and Tag."	High Range "P.M. high."
Distance from bottom of bulb	to 20° line, 75 to 90 mm.	to 200° line, 75 to 90 mm.
Distance from top of stem	to 230° line, 25 to 40 mm.	to 700° line, 25 to 40 mm.
Expansion chamber	Required.	None.
Filled	Nitrogen gas.	Nitrogen gas.
Top finish	Glass ring.	Glass ring.
Graduating	All lines, figures, and letters clear cut and distinct. Scale graduated in 1° divisions. Scale numbered every 10°, the first and each succeeding 5° line to be longer than the others.	All lines, figures, and letters clear cut and distinct. Scale graduated in 5° divisions. Scale numbered every 50°, the first and each succeeding 25° line to be longer than the others.
Special marking	"A.S.T.M. P.M. and Tag," serial number, manufacturer's name or trade mark etched on the stem.	"A.S.T.M., P.M., high," serial number, manufacturer's name or trade mark etched on the stem.
Accuracy	Error at any point in scale shall not exceed 1° F.	Error at any point in scale shall not exceed ½ smallest scale division.
Test for permanency		After being subjected to a temperature of 680° F. for 24 hours the accuracy shall be within the limit specified.
Points to be tested	32°, 100°, 150°, 212° F.	212°, 450°, 700° F.

II. PROCEDURE.

3. (*a*) All parts of the cup and its accessories shall be thoroughly clean and dry before starting the test. Particular care shall be taken to avoid the presence of any gasoline or naphtha used to clean the apparatus after a previous test.

(*b*) The cup shall be filled with the oil to be tested up to the level indicated by the filling mark.

(*c*) The lid shall be placed on the cup and the latter set in the stove. Care shall be taken to have the locating devices properly

engaged. The thermometer shall be inserted. If it is known that the oil will flash above 220° F. the "P.M. high" thermometer may be selected; otherwise, it is preferable to start with the "P.M. and Tag" thermometer and change in case a temperature of 220 to 230° F. is reached.

(*d*) The test flame shall be lighted and adjusted so that it is of the size of a bead $\frac{5}{32}$ in. (3.97 mm.) in diameter.

(*e*) Heat shall be supplied at such a rate that the temperature read on the thermometer increases not less than 9 nor more than 11° F. per minute. The stirrer shall be turned at a rate of from 1 to 2 revolutions per second.

(*f*) Application of the test flame shall be made at each temperature reading which is a multiple of 2° F. up to 220° F. For the temperature range above 220° F., application shall be made at each temperature reading which is a multiple of 5° F. The first application of the test flame shall be made at a temperature at least 30° F. below the actual flash point. Application of the test flame shall be made by operating the device controlling the shutter and test flame burner so that the flame is lowered in one-half second, left in its lowered position for one second, and quickly raised to its high position. Stirring shall be discontinued during the application of the test flame.

Flash Point.

4. The flash point is taken as the temperature read on the thermometer at the time of the flame application that causes a distinct flash in the interior of the cup. The true flash must not be confused with the bluish halo that sometimes surrounds the test flame for the applications preceding the one that causes the actual flash.

Barometric Pressure.

5. The barometric pressure shall be observed and recorded. No corrections shall be made except in case of dispute when the flash point figure shall be corrected according to the following rule:

For each inch (25 mm.) below 29.92 in. (760 mm.) barometric reading add 1.6° F. to the flash point.

For each inch (25 mm.) above 29.92 in. (760 mm.) barometric reading subtract 1.6° F. from the flash point.

STANDARD METHODS
OF
SAMPLING STONE, SLAG, GRAVEL, SAND AND STONE BLOCK FOR USE AS HIGHWAY MATERIALS.

INCLUDING SOME MATERIAL SURVEY METHODS.

Serial Designation: D 75 - 22.

These methods are issued under the fixed designation D 75; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE, 1920; ADOPTED, 1922.

1. Samples of all materials for test upon which is to be based the acceptance or rejection of the supply shall be taken by the engineer or his authorized representative. Samples for inspection or preliminary test may be submitted by a producer or owner of the supply.

I. SAMPLING OF STONE.

Inspection.

A. Sampling of Stone from Ledges or Quarries for Quality.

2. The ledge or quarry face shall be inspected closely to determine any variation in different layers. Any difference in color or structure shall be observed, and if necessary to secure unweathered specimens, pieces broken from different layers.

Sampling and Size.

3. (*a*) For standard stone test, separate samples shall be taken of at least 30 lb. each of fresh unweathered specimens from all layers that appear to vary in color or structure. When more than one piece is taken, the minimum size shall be 2 in., except that there shall be one piece of each sample of a minimum size of 4 by 5 by 3 in. on which the bedding plane is marked and which shall be free from seams or fractures to be used in the toughness or compression test.

(*b*) The sample for concrete test will depend on the kind of tests to be made and the number of specimens necessary.

Record.

4. In addition to the general information accompanying all samples, samples from local ledges not commercial sources shall

contain the following: Name of owner; approximate quantity available (if quantity is very large this can be recorded as practically unlimited); amount and character of overburden or stripping; haul to nearest point on road where the material is to be used; character of haul (kind of road and grade); also some detailed record of the extent and location of the material represented by each sample. For this purpose a sketch, plan and elevation showing the thickness and location of the different layers is recommended.

B. Sampling of Stone from Commercial Quarries.

For Quality.

5. Where practical, samples from commercial quarries shall be taken from the ledge or quarry face and the same procedure shall be followed as when sampling local ledges.

For Size.

6. At the plant, the following factors affect the size of broken stone: Size and shape of screen openings; length of screen sections; the angle of screen with horizontal; the speed of screen rotation; and the rate at which the screen is fed. A general inspection and record of these conditions shall be made. The sample shall be taken preferably from cars or boats while loading from stock piles or bins. It is recommended, in order that the sample may be representative, that separate samples be taken at different times while the material is being loaded. If the sample has to be taken from the bin or stock pile, several samples shall be taken from different parts of the stock pile and from the top of the bin and the loading chute. These separate samples shall be well mixed in a composite sample and the sample for test obtained by the quartering method.

Sampling at Delivery.

7. (*a*) Where it is not practical to visit the plant, samples for both quality and size shall be taken from different parts of the car or boat during unloading. It is recommended that separate samples be taken from the top, middle and bottom of car or boat. These separate samples shall be well mixed in a composite sample and the sample for test obtained by the quartering method. The results of tests on crushed stone for quality are not considered comparable with results from samples specially broken for test in the laboratory, but the general quality of the stone can be ascertained and check tests on various shipments should indicate any change in quality. In this case, tests for both quality and size can be made on the same sample.

(*b*) Where test is to be made for size only, it is recommended that a small set of screens and a pair of scales or some unit measure receptacle for measuring volume be used for field testing in order not to delay decision on the use of the material. Occasional check tests can be obtained from the laboratory to assure a fair degree of accuracy in field testing.

Size of Samples.

8. (*a*) The sample of crushed stone for mechanical analysis shall weigh at least 50 times the weight of the largest piece therein.

(*b*) The sample for concrete test will depend on the kind of tests to be made and the number of specimens necessary.

C. Sampling of Field Stone and Boulders.

For Quality.

9. A detailed inspection of the deposits of field stone and boulders, over the area where the supply is to be obtained, shall be made. The different kinds of stone and its state of preservation in the various deposits shall be recorded.

Separate Samples.

10. Separate samples shall be taken of all stone of different classes that a visual inspection indicates, from state of preservation and degrees of lamination, would be considered for use in construction.

Record.

11. Records accompanying samples of field stone and boulders, in addition to general information, shall contain the following:

(*a*) Location of supply;

The plotting of the field stone and boulder area on a U. S. topographic or a similar map is recommended for this purpose.

(*b*) Approximate quantity available;

A fairly accurate estimate of amount of stone in fences can be made by measuring a cross-section and pacing the length. It is more difficult to estimate the amount of stone scattered on the ground and ordinarily such deposits do not pay to work unless quite congested.

(*c*) Information regarding the percentage of different classes of stone which were sampled and the percentages of material which can be rejected by visual examination and may have to be handled and spoiled.

This information regarding the percentages of different kinds of material can only be estimated and the degree of accuracy attained will depend almost entirely upon the experience and skill of the individual.

II. SAMPLING OF BLAST-FURNACE SLAG.

12. It is recommended that blast-furnace slag be sampled for size and quality by the method specified for broken stone. **For Size and Quality.**

III. SAMPLING OF SAND AND GRAVEL.

A. Non-Commercial Deposits.

13. Non-commercial as used here includes all undeveloped sand and gravel deposits and all developed deposits where the material is not washed or screened. **Definition.**

14. (*a*) The investigator should realize that few if any natural sand and gravel deposits are uniform, and when a sample is taken the quantity of material in the deposit similar to the sample shall be ascertained as nearly as possible. **Sampling.**

(*b*) Where possible, samples of sand shall be taken when it is in a damp condition.

(*c*) If the deposit is worked as a bank or pit and has an open face, the sample shall be taken by channeling the open face so as to represent material that visual inspection indicates could be used. Care shall be taken to eliminate any overburden or stripping at the top or any that has fallen along the face from the top. It is necessary, especially in small deposits, to excavate test pits some distance back of and parallel to the face to determine the extent of the supply. The number and depth of these pits depend on the quantity of material that is to be taken from the deposit. Separate samples shall be taken from the face of the bank and from test pits. These shall be well mixed in a composite sample and the sample for test obtained by the quartering method.

(*d*) Deposits that have no open face shall be sampled by means of test pits. The number and depth of these will depend on local conditions and the amount of material to be used from the source. A separate sample shall be taken from each pit and where visual examination indicates no radical difference in size of grain, color, etc., these shall be well mixed in a composite sample and the sample for test obtained by the quartering method. Where visual inspection indicates a distinct difference in material from different pits, separate samples shall be taken for test.

(*e*) It is suggested that the colorimetric test be used for determining the percentage of organic material.[1]

[1] For a description of this test, see the Standard Method of Test for Organic Impurities in Sands for Concrete (Serial Designation: C 40) of the American Society for Testing Materials. See p. 19.

Record.

15. In addition to the general information accompanying all samples from sand and gravel deposits not commercial sources, the same detailed information shall be supplied as with samples of stone taken from local ledges.

B. Commercial Sand and Gravel Plants.

Sampling for Quality.

16. Samples of both sand and gravel from commercial screening or washing plants shall be taken from the bins or storage piles preferably while the material is being loaded from these supplies. The sand and gravel shall be sampled as separate units and shipped as such. It is difficult to secure a representative sample from stock piles and bins and, if conditions require sampling from these sources, the following is recommended: Separate samples shall be taken from different parts of the stock pile, care being taken to avoid sampling a segregated area of coarse-grained material which is likely to exist at the base of the pile. In sampling from a bin, separate samples shall be taken from the top and the loading chute. At the latter place at least $\frac{1}{2}$ cu. yd. of material shall be run off and representative samples taken from it. These separate samples shall be well mixed in a composite sample and the sample for test obtained by the quartering method.

Sampling for Size.

17. The size of sand and gravel will be affected by the same factors as broken stone and the same inspection is necessary. In addition, the relative amount of water used in screening must be taken into consideration. The same procedure for taking a sample of broken stone for size is recommended for sampling sand and gravel for size, both at plant and at delivery.

Sampling at Delivery.

18. Where it is not practical to visit the plant, samples for both quality and size shall be taken from different parts of the car or boat during unloading. It is recommended that separate samples be taken from the top, middle and bottom of car or boat. These separate samples shall be well mixed in a composite sample and the sample for test obtained by the quartering method.

C. Quantity of Sand and Gravel Samples.

Run of Bank.

19. Samples of run of bank (where the sand and gravel are combined) shall consist of at least 100 lb. of material where the gravel content is 50 per cent or more of the whole. If the gravel is less in percentage, the sample shall be increased in proportion. For example, where the gravel percentage is 25 per cent of the whole the sample should contain 200 lb.

20. Samples of sand shall contain at least 20 lb. of material. Sand.

21. Samples of gravel shall contain at least 50 lb. of material. Gravel.

22. The sample for concrete test will depend on the kind of tests to be made and the number of specimens necessary. Sample for Concrete Test.

IV. SAMPLING OF MISCELLANEOUS MATERIALS.

23. Samples of slag, sand, screenings, mine tailings, and all other materials used as a substitute for sand and gravel or broken stone, shall be inspected in the same manner and samples taken in the same way as the materials for which they are substituted.

V. SAMPLING OF STONE BLOCK.

24. Samples shall be taken either at the quarry or from cars or boats as directed by the engineer. They shall be representative of the block which it is proposed to use and no sample shall include blocks that would be rejected by visual inspection. Where Sampled.

25. The sample shall consist of at least six blocks and the bedding plane shall be marked on at least two of these. Size of Sample.

VI. GENERAL DIRECTIONS FOR SHIPPING AND MARKING SAMPLES.

26. Samples of ledge stone, crushed stone and slag shall be shipped in a secure box or bag. Stone and Slag.

27. Samples of stone block shall be securely crated. Stone Block.

28. Samples of run of bank gravel, sand screenings, and other fine material, shall be shipped in a tight box or closely woven bag so there shall be no loss of the finer particles. Gravel, Sand, Etc.

29. Each sample or separate container shall be accompanied by a card or regular form, preferably in the container, giving the following information: By whom taken, official title or rank of the sampler; by whom submitted; source of supply; proposed use for the material; and in case of commercial supplies, daily production; geographic location, shipping facilities (name of railroad, canal or river, or other common carrier); and price of the material. Marking.

STANDARD METHODS OF TESTING MOLDED INSULATING MATERIALS.

Serial Designation: D 48 – 22.

These methods are issued under the fixed designation D 48; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE, 1917; ADOPTED IN AMENDED FORM, 1922.

Material Covered.

1. These tests are intended to apply to all solid insulating materials that are formed in molds by the application of pressure, either with or without heat.

I. TENSILE STRENGTH.

Apparatus.

2. Any standard testing machine may be used. Special clips (see Fig. 1) of hardened steel shall be used, hung from links held in the jaws of the machine, so that the pull is central at all times, to avoid any transverse strain.

Specimen.

3. The standard test specimen shown in Fig. 1 shall be used for the tension test. It shall be molded in a hardened and ground steel mold to the dimensions given in Fig. 1.

Method

4. (*a*) Five specimens shall be tested in the condition in which they are received.

Three specimens shall be tested after heating in an oven for one hour at a temperature which is 10° C. (18° F.) below the distortion point of the material, as determined in accordance with Sections 18 to 21. Each specimen shall be taken from the oven and tested immediately while hot.

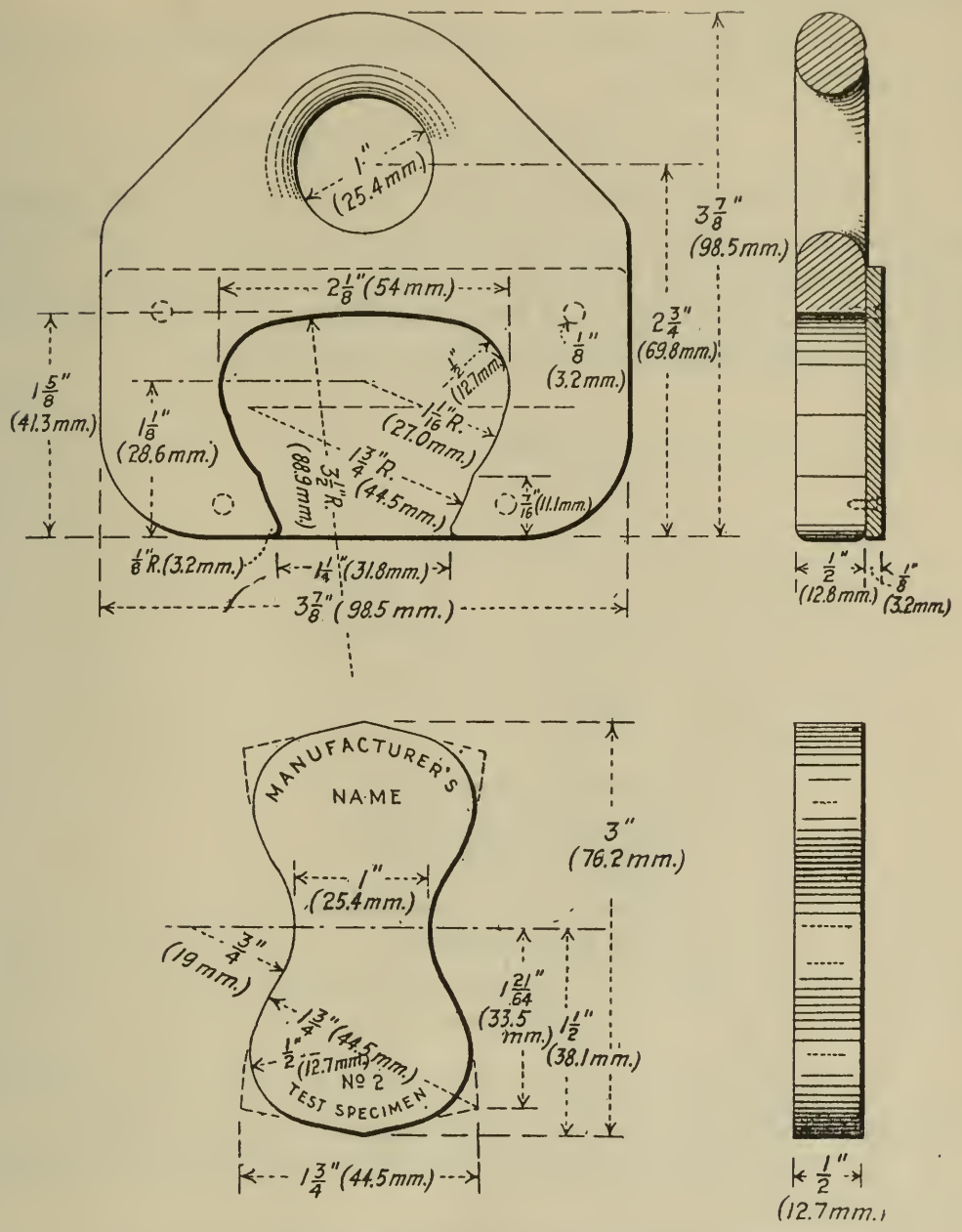
Two specimens shall be tested after they have been entirely immersed in water for 48 hours at normal room temperature. The specimens shall be pulled apart at normal room temperature of about 20° C. (68° F.) after the surface water has been removed by wiping with a dry cloth.

(*b*) The test specimen shall be pulled apart at such a speed that the beam can be kept well balanced. All tests shall be made at normal room temperature of about 20° C. (68° F.). Measurements may be taken at intervals during the test to show the elongation of the specimen when required for elastic materials.

5. The report of test shall include: **Report.**

(*a*) The breaking load of each specimen in pounds or kilograms;

(*b*) The thickness of each specimen in inches or centimeters as



Make Steel Mold to these Dimensions. Limits ± 0."002 (0.05mm.)

FIG. 1.—Tension Test Specimen (Specimen No. 2).

measured by a micrometer at the center of the specimen, that is, the point of minimum section.

(*c*) The ultimate tensile strength in pounds per square inch or in kilograms per square centimeter of each specimen, calculated from

the minimum area measured at the center of the test specimen before the load is applied.

(*d*) The character of the material tested, with description of how it acts under stress.

(*e*) The speed in inches or centimeters per minute at which the jaws traveled during the test.

II. COMPRESSIVE STRENGTH.

Apparatus. 6. Any standard testing machine may be used. The pressure head used for standard compressive strength tests of cement blocks is satisfactory for this purpose. A sheet of soft annealed, copper about $\frac{1}{32}$ in. (1 mm.) thick, or heavy blotting paper, shall be placed above and below the specimen to equalize irregularities.

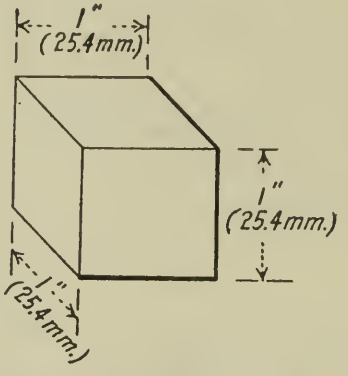


FIG. 2.—Compression Test Specimen (Specimen No. 3).

Specimen. 7. The test specimen shall be molded in the form of a cube from a hardened steel mold, ground to the dimensions shown in Fig. 2.

Method. 8. (*a*) Five specimens shall be crushed in the condition in which they are received.

Three specimens shall be crushed after heating for one hour at a temperature which is 10° C. (18° F.) below the distortion point of the material as determined in accordance with Sections 18 to 21. Each specimen shall be taken from the oven and tested immediately while hot.

Two specimens shall be crushed after immersion in water at normal room temperature for 48 hours, with all surface water wiped off with a dry cloth.

(*b*) The load shall be applied in a direction at right angles to that in which the pressure was applied in molding, and at such a rate of speed that will permit the beam to be kept well balanced from zero load until the specimen is crushed. For the best results use the slowest possible speed.

9. The report of test shall include: **Report.**

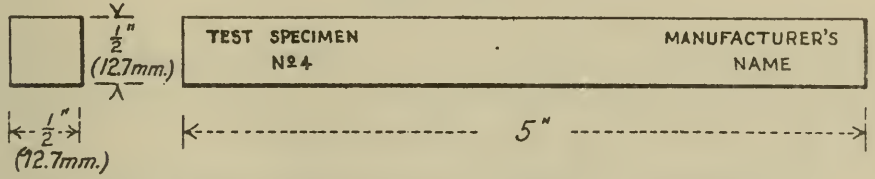
(*a*) The dimensions of each specimen in inches or in millimeters;

(*b*) The load in pounds or kilograms, on each specimen at the first sign of failure;

(*c*) The ultimate compressive strength in pounds per square inch or kilograms per square centimeter, of each specimen, calculated from the measured area of each specimen before the load is applied;

(*d*) The general character of the material tested, with description of how it acts under the applied load;

(*e*) The speed in inches or centimeters per minute at which the jaws traveled during the test.



Make Steel Mold to these Dimensions. Limits ±0."002 (0.05 mm.)

FIG. 3.—Transverse Test Specimen No. 4.

III. TRANSVERSE STRENGTH.

10. Any standard testing machine may be used. The specimen **Apparatus.** shall be supported on two steel blocks, with corners rounded to $\frac{1}{16}$-in. (1.5-mm.) radius. These supports shall be not more than 4 in. (102 mm.) nor less than 2 in. (51 mm.) apart. The load shall be applied on top of the specimen in a direction at right angles to the direction in which the piece was molded, by means of a wedge-shaped pressure piece, the edge of which is rounded to a $\frac{1}{8}$-in. (3-mm.) radius, extending across the specimen with the edge parallel to the edges of the two supports. The angle of the wedge shall be approximately 45 deg. and the load shall be applied at right angles to the specimen midway between the supports. The specimen shall be laid flat upon the supports at equal distances from the edge at each end.

11. The test specimen shall be molded from a hardened steel **Specimen.** mold, ground to the dimensions shown in Fig. 3.

12. (*a*) Four specimens shall be tested in the condition in which **Method.** they are received.

Three specimens shall be tested after immersion in water at normal room temperature for 48 hours with all surface water wiped off with a dry cloth.

(*b*) The load shall be applied at as slow a speed as possible, so that the beam may be kept well balanced from zero load until the first sign of failure. All tests shall be made at room temperature of about 20° C. (68° F.). Measurements of the deflection may be taken for very elastic materials.

Report.

13. The report of tests shall include:

(*a*) The thickness and width of each specimen as measured by a micrometer in inches or millimeters;

(*b*) The load on each specimen in pounds or in kilograms at the first sign of failure;

(*c*) The maximum fiber stress in pounds per square inch or in kilograms per square centimeter calculated from the formula:

$$S = \frac{3\ Pl,}{2\ bd^2}$$

in which S = maximum fiber stress, P = load applied, l = distance between the supports, b = width of specimen, and d = depth of specimen;

(*d*) The rate at which the load was applied;

(*e*) The amount of deflection at the center in inches or in millimeters;

(*f*) The distance between the supports in inches or in millimeters.

IV. DIELECTRIC STRENGTH.

Apparatus.

14. (*a*) Any well-designed high tension transformer connected to an alternating current supply having as nearly a true sine wave as possible, may be used. The transformer and the source of supply of energy shall be not less than 2 kva. for voltages of 50,000 volts or less, and not less than 5 kva. for voltages above 50,000 volts. The frequency shall not exceed 100 cycles per second.

(*b*) Regulation shall be so controlled that the high tension testing voltage taken from the secondary of the testing transformer can be raised gradually from any point and in no case more than 500 volts at a step. The control may be made by generator field regulation, with an induction regulator, or with a variable ratio auto transformer. Any method of regulating the voltage is satisfactory which does not distort the wave more than 10 per cent from a sinusoidal shape.

(*c*) The voltage may be measured by any approved method which gives root-mean-square values, preferably by means of a voltmeter connected to a special voltmeter coil in the high tension winding

of the testing transformer or to a separate step-down instrument potential transformer. A voltmeter on the low tension side of the transformer is satisfactory, if the ratio of transformation does not change under any test condition. An electrostatic voltmeter properly calibrated in the high tension circuit is also satisfactory. A spark gap may be used to check the readings at very high potentials.

(*d*) Some protection is desirable in the high tension circuit of testing transformers where the potential is 25,000 volts or over, to prevent dangerous surges and limit the current when the test specimen is punctured. It is, however, desirable to have as much energy available as possible when puncture occurs. If impedance in the form of choke coils be used in series with the high tension terminals, it should not be greater than that which will limit the high tension current to double the normal rated current of the testing transformer.

When a spark gap is used, a non-inductive resistance of about one ohm per volt may be inserted in series with one terminal of the spark gap, to damp high frequency oscillations at the time of breakdown and limit the current flow. This resistance shall be as near the gap as possible. If the test is made with one side grounded, this resistance shall be on the ungrounded side of the circuit, and if neither side is grounded the resistance shall be inserted one-half on each side of the spark gap. Water tube resistors are preferable to carbon for this purpose, as carbon resistance may be materially decreased by the passage of current.

(*e*) The apparatus used and the method of measuring the voltage shall meet the requirements of the standardization rules of the American Institute of Electrical Engineers.

15. The test specimen shall be molded to the dimensions shown in Fig. 4. The mold shall be hardened and ground to these dimensions. If the material cannot be molded to the full height shown, the height may be reduced to $1\frac{1}{4}$ in. (31.7 mm.). **Specimen.**

For materials having a puncture value higher than 300 volts per mil, the thickness of the bottom of the specimen may be reduced to 0.098 in. (2.5 mm.). It should be noted, however, that the apparent dielectric strength in volts per mil may be increased as much as 50 per cent when the thickness of the bottom of the specimen is so reduced.

16. (*a*) Voltage shall be applied to the test specimen by floating the specimen on mercury and placing a pool of mercury about $\frac{1}{8}$ in. (3 mm.) deep inside the specimen. **Method.**

It is recommended that all tests be made in air, but whenever it is impossible to puncture the specimen in air without arcing over the edge, it shall be immersed in high grade transformer oil. On speci-

mens which require a very high voltage to puncture, it may be necessary to put a glass tube or shield over the wire leading to the mercury on the inside of the specimen in order to prevent breakdown over the surface of the oil between terminals. The testing voltage shall be

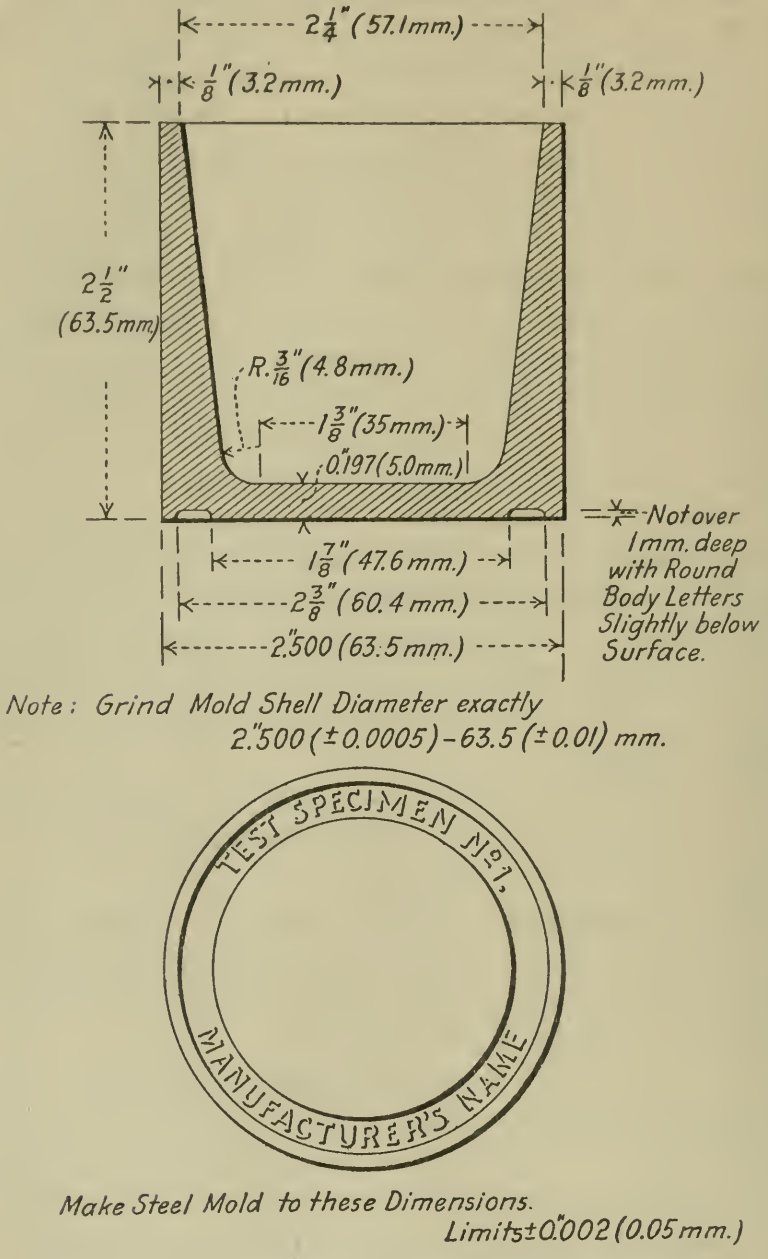


FIG. 4.—Test Specimen No. 1 for Dielectric Strength.

raised at a constant rate of approximately one thousand volts per second until puncture occurs.

(*b*) Five specimens shall be punctured in the condition received at normal room temperature of about 20° C. (68° F.) in order to determine the uniformity of the molded material.

Three specimens shall be punctured after heating one hour in an oven heated to 10° C. (18° F.) below the distortion point of the material as determined in Sections 18 to 21. The specimen shall be taken from the oven and immediately punctured in air while hot. This test is intended to cover all molded materials which do not withstand working temperatures above 125° C. (257° F.). Tests on materials which resist high temperatures may be made above 125° C. (257° F.) when required.

Two specimens shall be punctured after they have had the rim immersed in melted paraffin for a depth of 1 in. (25.4 mm.) and have been entirely immersed in water for 48 hours at normal room temperature of about 20° C. (68° F.). The surface of the specimen shall be wiped off with a dry cloth to remove all trace of excessive surface moisture and the puncture test immediately made.

(*c*) The results from specimens where puncture takes place up on the side of the specimen instead of through the bottom shall be discarded. Experience shows that very plastic materials which flow easily in the mold always puncture through the bottom, while materials which do not mold readily will often puncture through the side walls of the specimen at some distance up from the bottom.

17. The report of test shall include: **Report.**

(*a*) The thickness of the bottom of each specimen measured with a micrometer in the direction perpendicular to the bottom surface, and also the thickness at the point of puncture, regardless of the path taken by the discharge. The thickness of each specimen shall be given in mils or in millimeters;

(*b*) The puncture voltage of each test specimen expressed in terms of the effective (root-mean-square) value;

(*c*) The volts per mil or per millimeter as calculated from the measured thickness of the bottom of the specimen;

(*d*) The general character of the material tested with regard to leakage, if any is observed.

V. DISTORTION UNDER HEAT.

18. A special apparatus shall be used for this test as shown in Fig. 5. The specimen is supported on steel supports, 4 in. (102 mm.) apart with the load applied on top of the specimen vertically and midway between the supports, the same as for the transverse test, Section 10. The machine shall be arranged to apply a load of $5\frac{1}{2}$ lb. (2.5 kg.). The specimen shall be placed in an air bath surrounded by an oil bath which is so arranged that its temperature may be raised gradually. The machine shall be so arranged that the deflection of **Apparatus.**

the specimen at its center between the supports can be measured on a scale in mils or millimeters and shall be equipped with a thermometer so that the temperature of the specimen can be recorded at any time. The machine may be arranged to automatically shut off the heat and sound an alarm as soon as the required deflection is reached.

Specimen. 19. The same test specimen shall be used for this test as required for the transverse strength test, Section 11, molded from a hard steel mold ground to the dimensions given in Fig. 3.

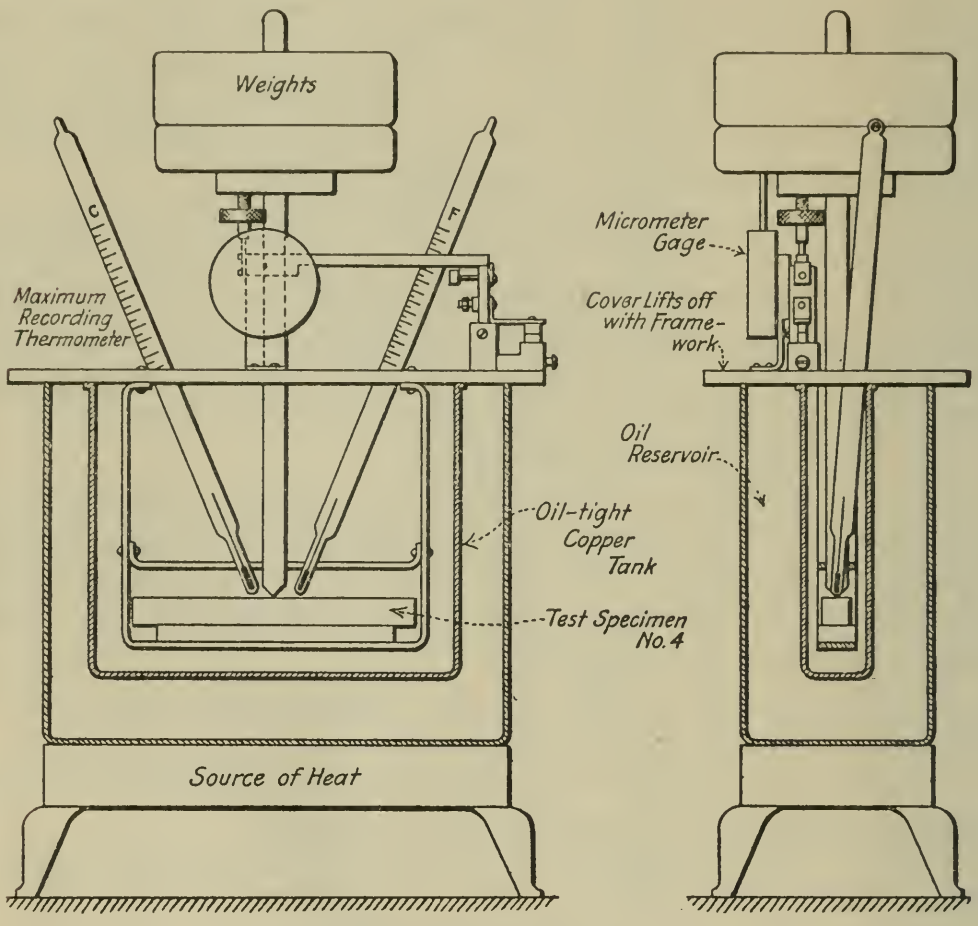


FIG. 5.—Machine for Temperature Tests.

Method. 20. Three test specimens shall be tested in the condition in which they are received, starting at normal room temperature of about 20° C. (68° F.) and increasing the temperature gradually at the rate of approximately 1° C. every two minutes.

The distortion point shall be considered the temperature at which the specimen has deflected 10 mils (0.254 mm.) at the center between the supports.

Report. 21. The report of test shall include:

(*a*) The breadth and depth of each specimen measured at the center with a micrometer in inches or in millimeters;

(*b*) The distortion point in degrees Centigrade or in degrees Fahrenheit;

(*c*) The length of time in minutes required for each specimen to deflect 10 mils (0.254 mm.);

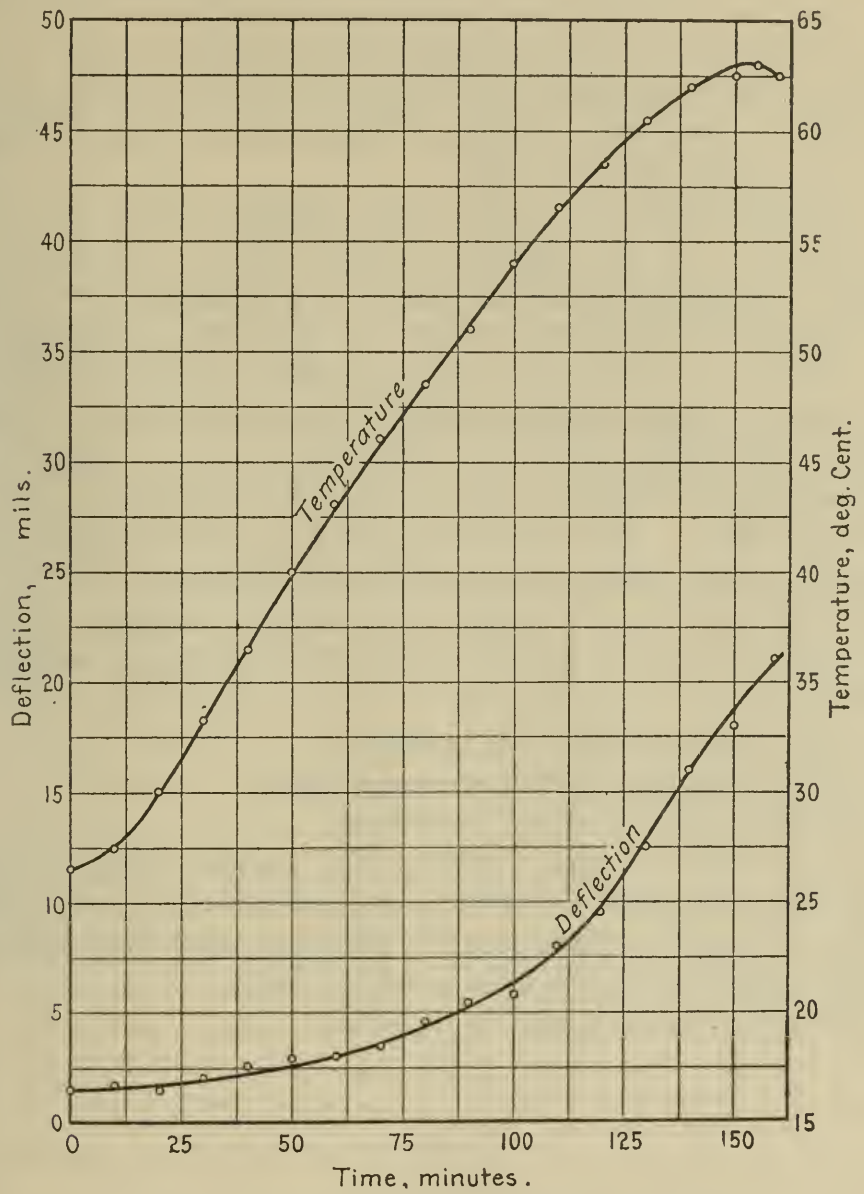


FIG. 6.—Typical Curve from Temperature Test.

(*d*) Any peculiar characteristics of the material as noted either during the test or after the specimen is removed from the machine;

(*e*) A curve for each test specimen showing the time in minutes horizontally and the amount of deflection and also the temperature at given intervals, as vertical ordinates as shown in Fig. 6.

EFFECT OF MOISTURE.

Apparatus. 22. Any good chemical balance, a beaker of water at normal room temperature of about 20° C. (68° F.), and an oven of any standard make capable of maintaining a uniform temperature of 100° C. (212° F.) with a variation allowed of ±5° C.

Specimen. 23. The test specimen No. 1 shown in Fig. 4 shall be used for this test. After the puncture tests prescribed in Section 16 (*b*), are completed on the five specimens, three of them shall be taken and the entire rim of each specimen shall be sawed off with a hack saw $\frac{1}{4}$ in. (6 mm.) back from the top edge of the specimen so as to expose a more or less uniformly cut surface.

Method. 24. Weigh each of the three test specimens after the rim has been sawed off. If the material softens readily at moderate temperatures, the specimen may be placed in a desiccator for 24 hours, or in an oven at a temperature of 50° C. (122° F.), permissible variation ±5° C., for 24 hours. For materials which do not soften readily, the specimen shall be placed in an oven heated to 100° C. (212° F.), permissible variation ±5° C., for 24 hours. After drying, the pieces shall be cooled in a desiccator and weighed again at normal room temperature. The specimens shall be placed in water, wholly immersed, for 100 hours at normal room temperature. They shall then be removed from the water at the end of 100 hours, all surface water wiped off with a dry cloth, and the specimens weighed immediately.

Report. 25. The report of test shall include:

(*a*) The original weight of each specimen;

(*b*) The dry weight of each specimen;

(*c*) The weight of each specimen after immersion for 100 hours;

(*d*) The percentage of moisture contained in each test specimen as received, and the percentage of moisture absorbed during the 100 hours, taking the dry weight as 100 per cent.

All weights shall be given in grams.

STANDARD DEFINITIONS OF TERMS RELATING TO PAINT SPECIFICATIONS.[1]

Serial Designation: D 16 – 22.

These definitions are issued under the fixed designation D 16; the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROPOSED AS TENTATIVE 1921; ADOPTED IN AMENDED FORM, 1922.

Size.—In the painting art, a liquid coating material, intended to close the pores, used to prepare a surface for further treatment. It is not regarded as a finishing material.

Varnish.—A liquid coating material, containing no pigment, which flows out to a smooth coat when applied and dries to a smooth, glossy, relatively hard, permanent solid when exposed in a thin film to the air.

Some materials possessing the other characteristics, dry without the usual gloss and are termed "flat varnish."

Enamel.—A special kind of paint which flows out to a smooth coat when applied and dries to a smooth, glossy, relatively hard, permanent solid when exposed in a thin film to the air. An enamel always contains pigment and has considerable hiding power and color. Some enamels dry to a flat or eggshell finish instead of a gloss finish.

Filler.—A special kind of paint used for filling pores or other small breaks in the continuity of a surface to render it smooth preparatory to further treatment. When applied and exposed to the air, a filler should dry to a relatively hard, permanent solid capable of properly supporting subsequent coats.

Toner.—An organic pigment which does not contain inorganic pigment or inorganic carrying base.

Lake.—A special type of pigment consisting essentially of an organic soluble coloring matter combined more or less definitely with an inorganic base or carrier. It is characterized generally by a bright color and a more or less pronounced translucency when made into an oil paint.

[1] These definitions of terms will be added to the present Standard Definitions of Terms Relating to Paint Specifications (Serial Designation: D 16 – 15) when the 1924 Book of A.S.T.M. Standards is issued

Under this term are included two (and perhaps three) types of pigment: (*a*) the older original type composed of hydrate of alumina dyed with a solution of the natural organic color, (*b*) the more modern and far more extensive type made by precipitating from solution various coal-tar colors by means of a metallic salt, tannin, or other suitable reagent, upon a base or carrier either previously prepared or coincidently formed, and (*c*) a number combining both types in varying degree, might be regarded as a third class.

Drying Oil.—An oil which possesses to a marked degree the property of readily taking up oxygen from the air and changing to a relatively hard, tough, elastic substance when exposed in a thin film to the air.

Semi-Drying Oil.—An oil which possesses the characteristics of a drying oil but to a less degree.

There is no definite line of demarcation between drying and semi-drying oils.

Non-Drying Oil.—An oil which does not of itself possess to a perceptible degree the power to take up oxygen from the air and lose its liquid characteristics.